

Application No. 10/596,359
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AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

Claims 1-22 (canceled).

Claim 23 (previously presented): The boundary acoustic wave device according to Claim 31, wherein the plurality of boundary acoustic wave elements are boundary acoustic wave filters or boundary acoustic wave resonators.

Claim 24 (previously presented): The boundary acoustic wave device according to Claim 31, wherein the plurality of boundary acoustic wave elements define resonators.

Claim 25 (previously presented): The boundary acoustic wave device according to Claim 31, wherein the boundary acoustic wave device is a longitudinally coupled filter.

Claim 26 (previously presented): The boundary acoustic wave device according to Claim 31, wherein the boundary acoustic wave elements are provided on a single piezoelectric single crystal substrate.

Claim 27 (previously presented): The boundary acoustic wave device according to Claim 31, wherein an electromechanical coefficient of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements.

Claim 28 (previously presented): The boundary acoustic wave device according

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to Claim 31, wherein a band width of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements.

Claim 29 (canceled).

Claim 30 (previously presented): The boundary acoustic wave device according to Claim 31, wherein a duty ratio of the interdigital electrodes is set so that the acoustic velocity of an SH type boundary acoustic wave is lower than the acoustic velocity of a slow transverse wave propagating through the solid layer and the acoustic velocity of a slow transverse wave propagating through the piezoelectric single crystal substrate.

Claim 31 (previously presented): A boundary acoustic wave device using a non-leaky propagation type boundary acoustic wave, comprising:

a plurality of boundary acoustic wave elements, each boundary acoustic wave element including a single crystal substrate, a solid layer provided on the single crystal substrate, and interdigital electrodes arranged at a boundary between the single crystal substrate and the solid layer; wherein

the single crystal substrates have a same cut angle;

a propagation direction of a boundary acoustic wave of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements;

a thickness of the solid layer is set such that energy of the boundary acoustic wave is not present on an outer surface of the single crystal substrate and is not present on an outer surface of the solid layer, the outer surface of the single crystal substrate and the outer surface of the solid layer are defined by respective surfaces of the single crystal substrate and the solid layer opposite to abutting surfaces of the single crystal substrate and the solid layer;

a thickness of the electrodes is set so that the acoustic velocity of an SH type

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boundary acoustic wave is lower than the acoustic velocity of a slow transverse wave propagating through the solid layer and the acoustic velocity of a slow transverse wave propagating through the piezoelectric single crystal substrate;

$H/\lambda > 8261.744\rho^{-1.376}$, when ρ (kg/m^3) represents the density of the electrodes, H represents the thickness of the electrodes, and λ represents the wavelength of a boundary wave, which is defined by a placement period of electrode fingers of the interdigital electrodes; and

$$\rho > 3,745 \text{ kg/m}^3.$$

Claim 32 (canceled).

Claim 33 (previously presented): The boundary acoustic wave device according to Claim 31, wherein $33,000.39050\rho^{-1.50232} < H/\lambda < 88,818.90913\rho^{-1.54998}$.

Claim 34 (previously presented): A boundary acoustic wave device using a non-leaky propagation type boundary acoustic wave, comprising:

a plurality of boundary acoustic wave elements, each boundary acoustic wave element including a single crystal substrate, a solid layer provided on the single crystal substrate, and interdigital electrodes arranged at a boundary between the single crystal substrate and the solid layer; wherein

the single crystal substrates have a same cut angle;

a propagation direction of a boundary acoustic wave of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements;

a thickness of the solid layer is set such that energy of the boundary acoustic wave is not present wave is not present on an outer surface if the single crystal substrate and is not present on an outer surface of the solid layer, the outer surface of the single crystal substrate and the outer surface of the solid layer are defined by respective surfaces of the single crystal substrate and the solid layer opposite to

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abutting surfaces of the single crystal substrate and the solid layer;

a thickness of the electrodes is set so that the acoustic velocity of an SH type boundary acoustic wave is lower than the acoustic velocity of a slow transverse wave propagating through the solid layer and the acoustic velocity of a slow transverse wave propagating through the piezoelectric single crystal substrate; and

the piezoelectric single crystal substrate is a LiNbO₃ substrate, ϕ of Euler angles (ϕ, θ, ψ) of the LiNbO₃ substrate is in the range of -31° to 31°, and θ and ψ are in the range surrounded by points A1 to A13 shown in the following Table 1:

Table 1

Points	ψ (°)	θ (°)
A01	0	116
A02	11	118
A03	20	123
A04	25	127
A05	33	140
A06	60	140
A07	65	132
A08	54	112
A09	48	90
A10	43	87
A11	24	90
A12	0	91
A13	0	116

Claim 35 (previously presented): The boundary acoustic wave device according to Claim 31, wherein the electrodes each include a main electrode layer made from a material selected from the group consisting of Au, Ag, Cu, Al, Fe, Ni, W, Ta, Pt, Mo, Cr, Ti, ZnO, and ITO.

Claim 36 (previously presented): The boundary acoustic wave device according to Claim 35, wherein the electrodes each further include an additional electrode layer laminated on the main electrode layer.

Claim 37 (previously presented): The boundary acoustic wave device according to Claim 36, wherein the solid layer includes a dielectric substance.

Claim 38 (previously presented): The boundary acoustic wave device according to Claim 37, wherein the dielectric substance includes a material primarily composed of SiO₂.

Claim 39 (previously presented): The boundary acoustic wave device according to Claim 37, wherein the solid layer includes a plurality of laminates, each of the plurality of laminates including a plurality of material layers.

Claim 40 (previously presented): The boundary acoustic wave device according to Claim 39, wherein the solid layer includes a layer primarily composed of SiO₂ laminated to a layer primarily composed of Si.

Claim 41 (previously presented): The boundary acoustic wave device according to Claim 37, wherein the solid layer includes at least one material selected from the group consisting of Si, SiO₂, glass, silicon nitride, silicon carbide, ZnO, Ta₂O₅, titanate zirconate lead piezoelectric ceramic, aluminum nitride, Al₂O₃, LiTaO₃, and LiNbO₃.

Claim 42 (previously presented): The boundary acoustic wave device according to Claim 31, wherein the boundary acoustic wave elements each further includes a resin layer adhered to the solid layer.

Claim 43 (previously presented): The boundary acoustic wave device according to Claim 34, wherein the plurality of boundary acoustic wave elements are boundary acoustic wave filters or boundary acoustic wave resonators.

Claim 44 (previously presented): The boundary acoustic wave device according to Claim 34, wherein the plurality of boundary acoustic wave elements define resonators.

Claim 45 (previously presented): The boundary acoustic wave device according to Claim 34, wherein the boundary acoustic wave device is a longitudinally coupled filter.

Claim 46 (previously presented): The boundary acoustic wave device according to Claim 34, wherein the boundary acoustic wave elements are provided on a single piezoelectric single crystal substrate.

Claim 47 (previously presented): The boundary acoustic wave device according to Claim 34, wherein an electromechanical coefficient of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements.

Claim 48 (previously presented): The boundary acoustic wave device according to Claim 34, wherein a band width of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements.

Claim 49 (previously presented): The boundary acoustic wave device according to Claim 34, wherein a duty ratio of the electrodes is set so that the acoustic velocity of an SH type boundary acoustic wave is lower than the acoustic velocity of a slow transverse wave propagating through the solid layer and the acoustic velocity of a slow transverse wave propagating through the piezoelectric single crystal substrate.

Claim 50 (previously presented): The boundary acoustic wave device according

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to Claim 34, wherein the electrodes each include a main electrode layer made from a material selected from the group consisting of Au, Ag, Cu, Al, Fe, Ni, W, Ta, Pt, Mo, Cr, Ti, ZnO, and ITO.

Claim 51 (previously presented): The boundary acoustic wave device according to Claim 50, wherein the electrodes each further include an additional electrode layer laminated on the main electrode layer.

Claim 52 (previously presented): The boundary acoustic wave device according to Claim 51, wherein the solid layer includes a dielectric substance.

Claim 53 (previously presented): The boundary acoustic wave device according to Claim 52, wherein the dielectric substance includes a material primarily composed of SiO₂.

Claim 54 (previously presented): The boundary acoustic wave device according to Claim 52, wherein the solid layer includes a plurality of laminates, each of the plurality of laminates including a plurality of material layers.

Claim 55 (currently amended): The boundary acoustic wave device according to Claim 53, wherein the solid layer includes a layer primarily composed of SiO₂ laminated to a layer primarily composed of Si.

Claim 56 (previously presented): The boundary acoustic wave device according to Claim 52, wherein the solid layer includes at least one material selected from the group consisting of Si, SiO₂, glass, silicon nitride, silicon carbide, ZnO, Ta₂O₅, titanate zirconate lead piezoelectric ceramic, aluminum nitride, Al₂O₃, LiTaO₃, and LiNbO₃.

Claim 57 (previously presented): The boundary acoustic wave device according

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to Claim 34, wherein the boundary acoustic wave elements each further includes a resin layer adhered to the solid layer.